

WHAT IS CLAIMED IS:

1. A semiconductor device comprising:

a reference voltage generating circuit which
generates reference voltage based on external power
supply voltage, the reference voltage generating
circuit outputting the generated reference voltage from
an output terminal thereof;

a voltage generating circuit whose input terminal
is connected to the output terminal of the reference
voltage generating circuit, the voltage generating
circuit lowering the external power supply voltage
according to the reference voltage supplied from the
reference voltage generating circuit to output internal
power supply voltage from an output terminal thereof;
and

at least one of first and second transistors
provided in the semiconductor device, the first
transistor having a current path connected between
a terminal to which the external power supply voltage
is supplied and the output terminal of the voltage
generating circuit and a gate supplied with constant
voltage and having negative threshold voltage and the
second transistor having a current path connected
between a terminal to which the external power supply
voltage is supplied and the output terminal of the
reference voltage generating circuit and a gate
supplied with constant voltage and having negative

threshold voltage.

2. The device according to claim 1, wherein the gate of the first transistor is connected to one of a ground node and the output terminal of the reference voltage generating circuit and the substrate thereof is connected to the output terminal of the voltage generating circuit.

3. The device according to claim 1, wherein the gate of the second transistor is grounded and the substrate thereof is connected to the output terminal of the reference voltage generating circuit.

4. A semiconductor device comprising:
a reference voltage generating circuit having first and second output terminals, the reference voltage generating circuit generating reference voltage based on an external voltage, outputting the thus generated reference voltage from the first output terminal, generating a control signal used to control a current source and outputting the thus generated control signal from the second output terminal;

a voltage generating circuit whose input terminal is connected to the first output terminal of the reference voltage generating circuit, the voltage generating circuit lowering external power supply voltage according to the reference voltage supplied from the first output terminal of the reference voltage generating circuit to output internal power supply

voltage from an output terminal thereof;

5 a first transistor having a current path connected between a terminal to which the external power supply voltage is supplied and the output terminal of the voltage generating circuit and a gate supplied with first voltage and having negative threshold voltage; and

10 at least one of second and third transistors provided in the semiconductor device, the second transistor having a current path connected between a terminal to which the external power supply voltage is supplied and the first output terminal of the reference voltage generating circuit and a gate supplied with second voltage and having negative threshold voltage
15 and the third transistor having a current path connected between a terminal to which the external power supply voltage is supplied and the second output terminal of the reference voltage generating circuit and a gate supplied with preset voltage and having
20 negative threshold voltage.

5. The device according to claim 4, wherein the first voltage is one of the reference voltage, voltage of the control signal and ground voltage.

25 6. The device according to claim 4, wherein the substrate of the first transistor is connected to the output terminal of the voltage generating circuit.

7. The device according to claim 4, wherein the

second voltage is one of the ground voltage and the voltage of the control signal.

8. The device according to claim 4, wherein the substrate of the second transistor is connected to the first output terminal of the reference voltage generating circuit.

9. The device according to claim 4, wherein the gate of the third transistor is grounded and the substrate thereof is connected to one of the second output terminal of the reference voltage generating circuit and the ground node.

10. The device according to claim 4, wherein each of the first to third transistors is configured by an N-channel transistor.

11. The device according to claim 4, wherein the reference voltage generating circuit includes a fourth transistor of a P-channel type having a current path connected at one end to a terminal to which the external power supply voltage is supplied; a fifth transistor of the P-channel type having a current path connected at one end to the other end of the current path of the fourth transistor; sixth, seventh and eighth transistors of the P-channel type having current paths connected at one-side ends to the other end of the current path of the fourth transistor, the sixth, seventh and eighth transistors being combined with the fifth transistor to configure a current mirror circuit;

a first resistor and first diode serially connected between the other end of the current path of the fifth transistor and the ground node; a second diode connected between the other end of the current path of the sixth transistor and the ground node; a second resistor and third diode serially connected between the other end of the current path of the seventh transistor and the ground node, the other end of the current path of the seventh transistor being used as the first output terminal; a ninth transistor of an N-channel type connected between the other end of the current path of the eighth transistor and the ground node, the gate of the ninth transistor being connected to the other end of the current path of the eighth transistor and the other end of the current path of the eighth transistor being used as the second output terminal; and a first operational amplifier having first and second input terminals and a first output terminal, the first and second input terminals of the first operational amplifier being connected to the other ends of the current paths of the sixth and fifth transistors and the first output terminal thereof being connected to the gate of the fourth transistor.

12. The device according to claim 11, wherein the first operational amplifier includes tenth and eleventh transistors of the P-channel type having current paths connected at one-side ends to the terminal to which

the external power supply voltage is supplied, the gates of the tenth and eleventh transistors being connected together; twelfth and thirteenth transistors of the N-channel type having current paths respectively connected at one-side ends to the other ends of the current paths of the tenth and eleventh transistors, one end of the current path of the twelfth transistor being connected to the gate of the ninth transistor, the gate of the twelfth transistor being used as the first input terminal, the gate of the thirteenth transistor being used as the second input terminal, and one end of the current path of the thirteenth transistor being used as the first output terminal of the first operational amplifier; and a fourteenth transistor of the N-channel type having a current path connected between the other ends of the twelfth and thirteenth transistors and the ground node, the gate of the fourteenth transistor being connected to the second output terminal of the reference voltage generating circuit.

13. The device according to claim 11, wherein the voltage generating circuit includes a second operational amplifier; and a regulator circuit connected to the second operational amplifier;

the second operational amplifier including fifteenth and sixteenth transistors of the P-channel type having current paths connected at one-side ends to

the terminal to which the external power supply voltage is supplied, the gates of the fifteenth and sixteenth transistors being connected together; seventeenth and eighteenth transistors of the N-channel type having
5 current paths respectively connected at one-side ends to the other ends of the current paths of the fifteenth and sixteenth transistors, one end of the current path of the eighteenth transistor being connected to the gate of the fifteenth transistor, and the gate of the
10 seventeenth transistor being connected to the first output terminal of the reference voltage generating circuit; and a nineteenth transistor of the N-channel type having a current path connected between the other ends of the seventeenth and eighteenth transistors and
15 the ground node, the gate of the nineteenth transistor being connected to the second output terminal of the reference voltage generating circuit; and

the regulator circuit including a twentieth transistor of the P-channel type having a current path
20 connected at one end to the terminal to which the external power supply voltage is supplied, the gate of the twentieth transistor being connected to one end of the current path of the seventeenth transistor; and third and fourth resistors serially connected between
25 the twentieth transistor and the ground node, a connection node of the third and fourth resistors being connected to the gate of the eighteenth transistor and

the internal power supply voltage being output from a connection node of the twentieth transistor and the third resistor.

14. A semiconductor device comprising:

5 a reference voltage generating circuit which generates reference voltage based on external power supply voltage, the reference voltage generating circuit outputting the generated reference voltage from an output terminal thereof;

10 a voltage generating circuit whose input terminal is connected to the output terminal of the reference voltage generating circuit, the voltage generating circuit lowering the external power supply voltage according to the reference voltage supplied from the
15 reference voltage generating circuit to output internal power supply voltage from an output terminal thereof;
and

 a transistor having a current path connected at one end to a terminal to which the external power
20 supply voltage is supplied and connected at the other end to one of the output terminal of the voltage generating circuit and the output terminal of the reference voltage generating circuit, the transistor being supplied with constant voltage at a gate thereof
25 and having negative threshold voltage.

15. The device according to claim 14, wherein the gate of the transistor is grounded and the substrate

thereof is set at the same potential as the other end of the current path of the transistor.

16. A semiconductor device comprising:

5 a reference voltage generating circuit having first and second output terminals, the reference voltage generating circuit generating reference voltage based on external voltage, outputting the generated reference voltage from the first output terminal, generating a control signal used to control a current
10 source and outputting the thus generated control signal from the second output terminal;

a voltage generating circuit whose input terminal is connected to the first output terminal of the reference voltage generating circuit, the voltage
15 generating circuit lowering external power supply voltage according to the reference voltage supplied from the first output terminal of the reference voltage generating circuit to output internal power supply voltage from an output terminal thereof;

20 a first transistor having a current path connected between a terminal to which the external power supply voltage is supplied and the output terminal of the voltage generating circuit and a gate supplied with first voltage and having negative threshold voltage;
25 and

a second transistor having a current path connected between a terminal to which the external

power supply voltage is supplied and the second output terminal of the reference voltage generating circuit and having negative threshold voltage, a gate of the second transistor being grounded.

5 17. The device according to claim 16, wherein the first voltage is one of ground voltage and voltage of a signal supplied from the second output terminal of the reference voltage generating circuit.

10 18. The device according to claim 16, wherein the substrate of the first transistor is connected to the output terminal of the voltage generating circuit.

15 19. The device according to claim 16, wherein the substrate of the second transistor is connected to one of the ground node and the second output terminal of the reference voltage generating circuit.

20 20. The device according to claim 16, further comprising a third transistor having a current path connected between the terminal to which the external power supply voltage is supplied and the first output terminal of the reference voltage generating circuit and having negative threshold voltage, a gate of the third transistor being connected to one of the ground node and the second output terminal of the reference voltage generating circuit and a substrate thereof
25 being connected to the first output terminal of the reference voltage generating circuit.